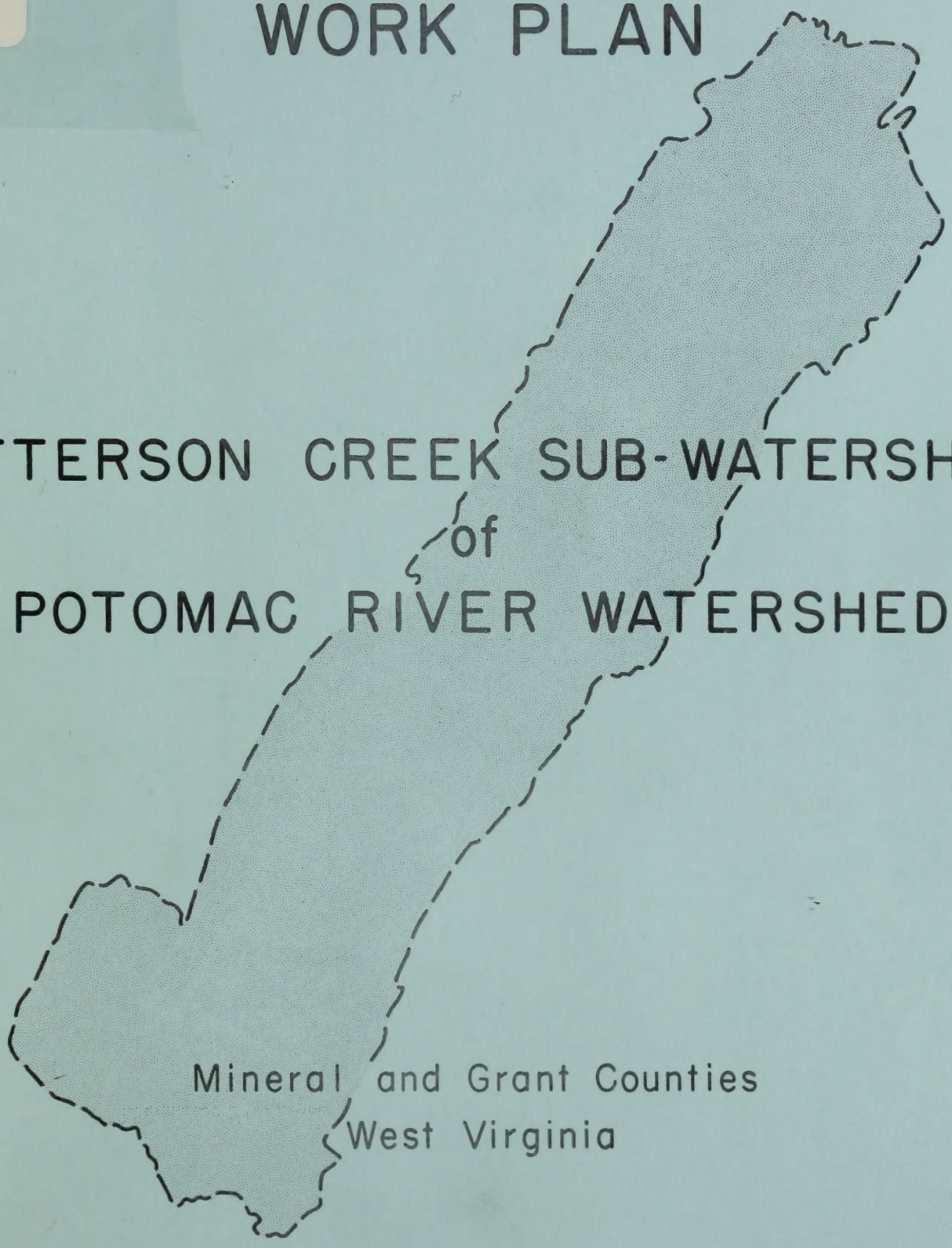
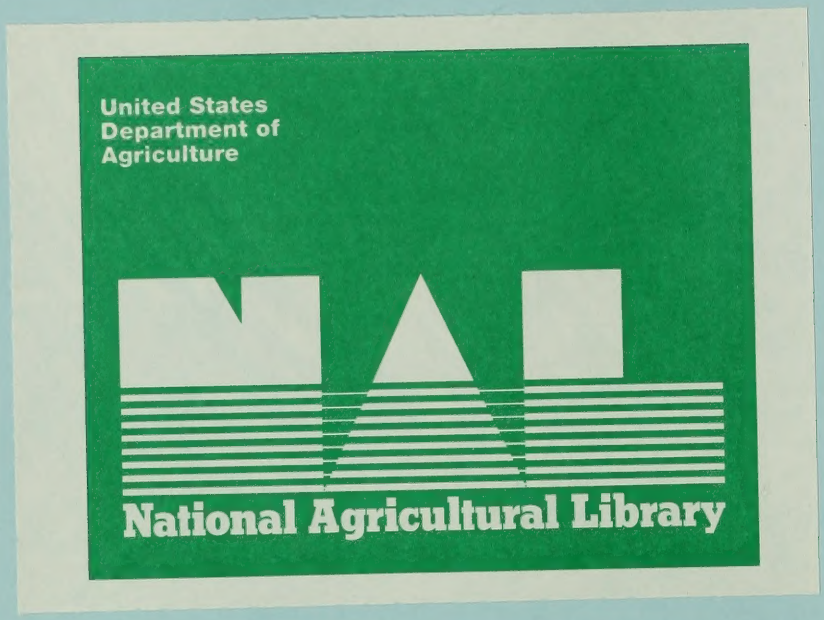
WORK PLAN



PATTERSON CREEK SUB-WATERSHED
of
POTOMAC RIVER WATERSHED

Mineral and Grant Counties
West Virginia

April 1962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WORK PLAN

PATTERSON CREEK SUB-WATERSHED OF THE POTOMAC RIVER

Mineral and Grant Counties

West Virginia

Prepared under the authority of the
Flood Control Act, P. L. 534
December 22, 1944

Prepared by:

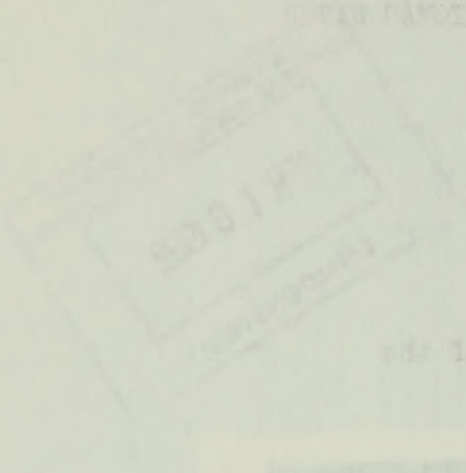
Potomac Valley Soil Conservation District

Fort Ashby Public Service District

With assistance by:

Local committees of the Patterson Creek Sub-Watershed
U. S. Department of Agriculture, Soil Conservation Service
U. S. Department of Agriculture, Forest Service
West Virginia Department of Natural Resources

April 1962



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PATTERSON CREEK SUB-WATERSHED OF THE POTOMAC RIVER

Mineral and Grant Counties

West Virginia

April 1962

INTRODUCTION

Authority

The provisions of the Flood Control Act, approved June 22, 1936, (49 Stat. 1570) as amended and supplemented, give authority to the United States Department of Agriculture to investigate a program for flood prevention and watershed protection in the Patterson Creek Sub-Watershed of the Potomac River. Authority and funds for carrying out the federal obligations of this work plan will be provided under the provision of Public Law 534, approved December 22, 1944, and its subsequent amendments. Participation by other federal agencies will follow authorizations specifically and currently applicable.

Purpose and Scope of Plan

The purpose of the plan for the Patterson Creek Sub-Watershed is to outline the land treatment and structural measures necessary to achieve the maximum practical erosion control, to alleviate flood damage, and to provide a public water supply for the community of Fort Ashby. The proposed measures represent the combined thinking of the local people and representatives of the cooperating agencies.

Installation of the proposed project will assist in providing floodwater protection to dwellings, roads, fields, crops, and businesses. It will permit more intensive land use by reducing damage to land in

the flood regions and also make uplands, presently decreasing in value as a result of erosion, once again attractive and productive. The entire economy will be improved as agricultural and forest income is increased. More than 4,000 acres will be established in long-term hay stands, 11,000 acres of pasture will be improved, and 5,000 acres will be subsoiled. Over 2,000 acres of woodland will receive cultural operations designed to improve hydrologic conditions through increased development of litter and humus and the maintenance of adequate vegetative cover. Land use will be adjusted to reduce runoff by tree planting on 750 acres. In addition, many technical services will be provided individual landowners in the way of surveys, plans, and supervision to accomplish the dual purpose of improving the farm economy and protecting the watershed. The plan will also provide increased recreational facilities such as fishing, boating, and picnicking.

This work plan also provides for a multiple-purpose structure in the vicinity of Fort Ashby. The people of this rural community have an inadequate supply of high quality water. This need would be met by including storage for a public water supply in structure #46. Provisions are also being made for water treatment and distribution.

Upon completion and with adequate maintenance of the measures set forth in this plan, a material contribution will have been made not only to the farms and communities of Mineral and Grant Counties but also to the state and the nation as a whole.

SUMMARY OF PLAN

The Patterson Creek Sub-Watershed is a land area of 181,248 acres located in Mineral and Grant Counties. This project is sponsored by the Potomac Valley Soil Conservation District and the Fort Ashby Public Service District. It will be installed during a ten-year period at a total installation cost of $5,797,800.

With the installation of this project there will be a major reduction of the following problems: (1) flooding of crops and agricultural improvements; (2) severe damage to roads, bridges, and culverts; (3) floodwater and sediment damages to residential and business establishments; and (4) an inadequate supply of approved water for the rural community of Fort Ashby.

The problems will be solved largely through the application of an overall sub-watershed management plan consisting of (1) land treatment measures in the upland areas designed to increase moisture absorption and reduce runoff and (2) structural measures, including 34 retarding structures, one multiple-purpose dam, and 4,497 feet of channel improvement. These land treatment and structural measures will be installed within a ten-year period and will reduce average annual damages 73 percent.

The total installation cost of the measures as listed in Table 1 is estimated to be $5,797,800. The total Public Law 534 share of the cost is estimated to be $4,832,000. Other funds (all funds other than P. L. 534) include the cost of installing land treatment measures, the cost allocated to municipal water, as well as the costs of providing the necessary land, easements, and rights-of-way for the structural measures, and the cost of administering the contract for structure #46.

This amount is estimated to be $965,800. The Fort Ashby Public Service District will pay $73,800 which is the cost other than P. L. 534 for structure #46. The Soil Conservation Service will pay the entire cost of construction and installation services allocated to flood prevention. The Soil Conservation Service will also pay for administering the contracts for all structural measures except structure #46. This estimated cost is $4,802,600. In addition, P. L. 534 funds will provide $11,300 for the Soil Conservation Service to furnish the technical assistance for installing the land treatment measures on open land. The U. S. Forest Service, in cooperation with the West Virginia Department of Natural Resources, will furnish the technical assistance for the woodland measures. The amount of the technical assistance furnished by the Forest Service from P. L. 534 funds is estimated to be $18,100. While the sponsoring local organizations have the responsibility for securing land, easements, and rights-of-way, the County Court of Mineral County will assist financially.

The maintenance of all of the floodwater retarding structures will be the legal responsibility of the sponsoring local organizations--the Potomac Valley Soil Conservation District and Fort Ashby Public Service District. The total annual maintenance cost is estimated to be $6,200.

The average annual benefits from all structural measures planned will be $275,404. (Refer to Table 6.) The estimated annual cost (installation cost amortized over fifty years plus the annual maintenance cost) will be $188,280. This results in a favorable benefit-cost ratio of 1.5 to 1.0 for all of the structural measures in this project.

DESCRIPTION OF THE WATERSHED

Physical Data

Patterson Creek, which is a tributary of the North Branch of the Potomac, rises in the northeastern part of Grant County, West Virginia, nine miles north of Petersburg, West Virginia, along what is known as "The Divide" and flows in a northeast direction through the eastern part of Mineral County. Early in the history of the area, George Washington surveyed a road across this divide from east to points in the west. This road, known as the Morgantown Road, follows the divide, entering Grant County from Hardy County. Along this survey the headwaters of Patterson Creek have their source. Patterson Creek empties into the North Branch of the Potomac River ten miles east of Cumberland, Maryland. The sub-watershed is about forty miles long and averages about eight miles in width.

The elevation of the highest point in the sub-watershed is over 3,500 feet. It is located on Allegheny Front near Scherr. The low point is about 560 feet at the confluence of Patterson with the North Branch of the Potomac River. Patterson Creek from Lahmansville to its confluence, a distance of 38 miles, has an average fall of 15 feet per mile.

This project includes all of the Patterson Creek Sub-Watershed, an area of 181,248 acres. Of this area, 62,464 acres are in Grant County, and 118,784 acres are in Mineral County. Present land use consists of 8,967 acres of crop land, 21,010 acres of permanent hayland, 40,633 acres of pasture, 105,954 acres of woodland, 3,060 acres of idle land, and 1,624 acres of miscellaneous.

Patterson Creek is a stream approaching maturity. The flood plain is wide with most of it between one-half mile and one mile in width. There are numerous meanders of recent origin. Due to the proximity of Patterson Creek Mountain on the east, the only two tributaries of any consequence entering from the east are Beaver Run and Elliber Run. A much larger gathering area extends the length of the valley on the west side of Patterson Creek. The principal tributaries flowing into Patterson Creek from the west include Plum, Turners, Georges, Cabin, and Staggs Runs, Mill Creek, Mike's, Rosser, and Thorns Runs, North Fork, and Middle Fork. These tributary streams provide most of the favorable sites for floodwater retarding structures.

Approximately 58 percent, or 105,954 acres, of the sub-watershed area is in forest cover. All of the forest land is in private ownerships.

It is estimated that 69 percent of the forest land supports stands of oak type with associates of basswood, hickory, and maple. Softwood stands of Virginia and pitch pine occupy 12 percent of the area and mixed stands 19 percent.

The most intensive land use occurs in the flood plain of Patterson Creek and its larger tributaries. The flood plain soils consist mainly of the Pope, Philo, Atkins, and Huntington, Lindside, and Melvin associations. The Huntington, Lindside, and Melvin soils consist of alluvium with some influence from limestone uplands; while the Pope, Philo, and Atkins soils are strongly acid. The Huntington and Pope soils are deep and well drained with high inherent fertility. The Lindside and Philo soils are moderately well drained to somewhat poorly drained, while the Melvin and Atkins soils are poorly drained.

The suitability of the bottomland soils for crop production is limited in varying degree by overflow. Lower lying areas flood annually.

The more productive limestone influenced Huntington, Lindside, and Melvin soils occur near the headwaters of Patterson Creek. Farther downstream, tributaries flowing from the infertile acid sandstone and shale uplands give rise to the Pope, Philo, and Atkins soils.

The Huntington and Pope soils, where use is not limited by overflow, are well adapted for all crops commonly grown in the area. They can be cropped intensively and respond well to irrigation supplemented by good fertility and other soil management practices. The Lindside and Philo soils are suitable for moderately intensive use. Many areas need some drainage for efficient production of row crops and alfalfa mixtures. The Melvin and Atkins soils usually need drainage. When drained, they are suitable for wet tolerant crops, grasses, and legumes and are capable of producing good pasture yields.

There are 7,172 acres of flood plain in the Patterson Creek Sub-Watershed. In the summer of 1960, 839 acres were in corn, 201 acres in small grain, 2,686 acres in pasture, and 1,886 acres in hay. The remaining acreage of flood plain was occupied by summer cottages, farmsteads, residential and commercial buildings, idle land, and other miscellaneous uses.

Average annual rainfall varies from approximately 43 inches near the headwaters to 35 inches in the lower portions of the sub-watershed. The average growing season is 149 days according to the Burlington record.

Economic Data

There are approximately 691 farms in the sub-watershed. Of this number, 201 are in Grant County and 490 are in Mineral County. Seventy-eight percent of the farmers living in the sub-watershed are now cooperating with the Potomac Valley Soil Conservation District. The more productive farms are located on the alluvial soils along Patterson Creek. Some of the gently sloping shale soils which border the flood plain are used for agricultural purposes. The Patterson Creek Valley is noted for its herds of purebred Aberdeen Angus cattle. Farmers are able to supplement their income from the cutting of pulpwood and the rental of cabins for vacation and recreational purposes. In the past most of the farm income has been from beef cattle, dairy products, chickens, lambs, hogs, wool, and timber. Very little grain is marketed from the area. In the last decade, commercial broiler production became a major source of income. Nearly all farms are owner-operated, and the economic status of the landowners is high for ridge and valley country. In Grant County, ten or twelve oil and gas companies have leased large acreages for one, five, or ten year periods. This may contribute to the economy of the area in the future.

Patterson Creek provides trout fishing on the headwaters and bass fishing on the remainder of the stream. The forested areas, bordering both sides of the valley, provide excellent hunting for grouse, squirrels, turkey, and deer.

The sub-watershed is well supplied with roads. U. S. Route #50 crosses the middle of the sub-watershed from east to west at Burlington.

A paved road extends from the northern to the southern end of the sub-watershed. A network of secondary roads provides access to all important points in the sub-watershed.

There are a number of small communities in the sub-watershed: Lahmansville, Forman, Medley, Scherr, Greenland, Falls, Williamsport, Martin, Russeldale, Burlington, Antioch, Ridgeville, Headsville, Reese's Mill, Champwood, Fort Ashby, Knobley, and Patterson Creek. Of the above, Burlington, Fort Ashby, and Patterson Creek are the most active commercial centers. Larger marketing and shopping centers are located outside the sub-watershed at Petersburg, Keyser, Romney, and Cumberland. The northern end of the sub-watershed is steadily gaining in population due to the influx of families from the industrial areas along the Potomac.

Past use of the forest land is responsible for the present stand size and condition class. A large percentage of the stands are immature but have a high potential for hydrologic improvement and production of timber crops. Sawtimber stands containing 1500 board feet or more per acre occupy 13 percent of the forest area, poletimber stands of 200 cubic feet and upward per acre in trees 5" to 11" DBH occupy 60 percent, and seedling and sapling stands 27 percent.

Given protection, care, and management, the forest stands will contribute materially to the economy of the sub-watershed.

SUB-WATERSHED PROBLEMS

Floodwater Damage

Severe floodwater damage has taken place on the flood plain from the upper reaches downstream to the confluence of Patterson Creek and the North Branch. As a result of the flat "table-top" type flood plain, any storm which produces out-of-bank flow will inundate the major portion of the flood plain. This area is subject to flooding in any season of the year. Records indicate that 50 percent of the past floods have occurred in the growing season. Some great losses have been sustained in the past. Earlier history reveals drownings in floodwaters at the Sally Smith Ford near Williamsport and considerable damage and loss to livestock in the March 17, 1936, flood. In more recent years, the damage to highways and bridges has been great. In May 1960 the water was over the road on U. S. Route 50 and U. S. 220 for more than six hours. The flooded fields in the spring greatly delay the planting season. On October 24, 1959, a flood occurred having a stage one to two feet higher than the 1960 flood. The October 1959 flood caused damage exceeding $300,000. The total average annual direct floodwater damage is estimated to be $185,382.

There are 132 farms in the flood plain of Patterson Creek and its tributaries. There are 2,112 acres on these farms flooded by the two-year frequency event. This has restricted the present use of this land.

Approximately 184 non-farm residences, summer cottages, and business establishments are subject to some damage from flooding at least once in five years. Some cottages near the channel are subject to damage

more frequently than this; and all of these improvements, together with many of the farm improvements, are subject to major flood damage from the more severe events.

The average annual indirect floodwater damage was determined to be $35,396. This damage is a result of numerous roads being flooded, bridges washed out, loss of utility service, and interrupting the normal schedule of many people.

Sediment Damage

The frequent flooding of the main stream deposits fine grained sediment over a large portion of the flood plain and coarser sediments at localized areas. The coarse infertile splays damage agricultural land directly through the loss of production. Natural levees are formed by the finer sediments causing a lesser amount of damage to productivity. An indirect effect is the impairment of natural drainage which constitutes a portion of the swamping damage. This sediment damage of overwash and swamping is an average annual amount of $66,163.

Erosion Damage

Out-of-bank flows have created scour channels throughout the flood plain. These damages are low in the wide flat areas but are high where the flows are confined and the velocities are greater. Average annual dollar damage is estimated to be $8,703.

Streambank erosion is not extensive in the sub-watershed. It is noticeable at localized points such as sharp meanders or where obstacles on one side of the channel have diverted the flows toward the opposite bank. The proposed project will have little effect on these localized points. There was no monetary value put on this damage.

Sheet erosion is most severe throughout the upland areas on the shallow shale soils. Overgrazed pasture and overcut forests are the major sediment sources of this area. The remainder of the watershed affords low rates of sheet erosion because of good cover conditions. The average rate of sheet erosion was computed to be 3.9 tons per acre per year.

Problems Relating to Water Management

The rural community of Fort Ashby has a water supply problem. At the present time the 500 residents of this community obtain their water from wells. In a few cases the water is acceptable in quality but is extremely limited in quantity. In general, however, the quality is very poor and the contamination from septic tanks presents a serious health hazard.

A general community meeting was held at Fort Ashby on April 11, 1961, to discuss the local water supply problem. A private consulting engineer presented the estimated cost of installing a complete water system, including storage in site #46, treatment, and distribution. A representative from the Farmers Home Administration explained the loan services available from his agency. The local people (property owners) voted overwhelmingly (61 to 1) to proceed with the formation of a Public Service District and the installation of a water system, including storage at site #46.

PROJECTS OF OTHER AGENCIES

There are no projects of other agencies within the Patterson Creek Sub-Watershed. This work plan fits into the comprehensive River Basin Plan for the Potomac River and will not be in conflict with proposals for the river basin.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

The agencies cooperating in carrying out this plan have decided that a sound watershed project must include the proper use and treatment of each acre of land within the sub-watershed in accordance with its needs for protection and improvement. The land treatment measures listed here and in Table 1 represent the kinds and quantities expected to be established during the ten-year project installation period which will produce measurable hydrologic effects in the sub-watershed. They do not, however, represent the total conservation needs of the sub-watershed nor all of the kinds of land treatment measures to be established in the area.

In order to increase the rate of infiltration and storage of water and reduce the amount of runoff and sedimentation, the following land treatment measures were selected for their value in sub-watershed protection:

Hayland Planting - 4,000 acres. Establishing long-term hay stands of grasses and/or legumes.

Pasture and Hayland Renovation - 11,000 acres. Establishing or re-establishing domesticated forage species in any manner on hay or pasture land.

Proper Pasture Use - 11,000 acres. Grazing pastures at a rate that will maintain grasses and legumes of high quality by adjusting the stocking rates or season of use to favor maximum growth and survival.

Subsoiling - 5,000 acres. Loosening the soil below the depth of normal tillage without inversion and with minimum mixing of the soil.

Tree Planting - 750 acres. The establishment of forest cover on certain open areas is necessary to adjust land use with capability and to reduce runoff and erosion by developing a protective cover and an absorbent forest floor "sponge" of humus and litter. Under such conditions the soil is protected, infiltration rates are improved, and the soil moisture storage capacity of the soil profile is increased.

Hydrologic Cultural Operations - 2,000 acres. These cultural operations are needed to improve forest hydrologic conditions through increased development of litter and humus and to maintain adequate vegetative cover for the soil. They include such treatments as thinnings, weedings, improvement and harvest cuttings aimed at favoring the establishment of desirable species and the maintenance of favorable stand and stocking conditions.

Woodland Grazing Control - 15 miles. The elimination of grazing by fencing naturally established or planted forest land is necessary if the optimum hydrologic condition of the forest is to be attained. Control of woodland grazing results in

the protection of vegetative cover from browsing and also prevents soil compaction from trampling. Ungrazed forest offers optimum conditions for good infiltration and storage of water in the soil profile.

Other Technical Assistance. Individual management plans will be prepared for 150 forest landowners, outlining practical measures to be applied in the immediate future to maintain and improve the hydrologic condition of the forest land. Other technical assistance is needed for various activities such as (a) stimulation of landowner interest and participation in the watershed program, (b) economic and hydrologic surveys, (c) general planning, supervision, and inspection of the program, (d) development of timber sale operating contracts and supervision of operations so that the removal of forest products will not damage sub-watershed values, (e) laying out of logging roads and skid trails to insure that sub-watershed values are not impaired.

Structural Measures

The structural measures in this plan include 35 floodwater retarding dams, one of which has multiple-purpose use, and 4,497 feet of stream channel improvement.

The retarding structures are of compacted earth fill with side slopes 3 : 1 for the upstream slope and $2\frac{1}{2}$: 1 on the downstream slope. Berms eight feet in width are placed along the side slopes at intervals to prevent erosion. A principal spillway consisting of a reinforced concrete conduit and riser is installed to control the release of the

floodwater of a storm in excess of the 100-year event. A vegetated emergency spillway is provided to handle the floodwater of the design storm. A minimum of two feet of freeboard above the design storm crest is provided to reduce the possibility of over-topping of the structure.

The multiple-purpose structure, site #46, at Fort Ashby will not only give floodwater protection, but also will include an additional 184.1 acre feet (60 million gallons) for municipal storage. An area of rip-rap will be placed on the upstream slope to provide wave action and drawdown protection. Any additional appurtenances as required by the local people will be coordinated in the final design of the structure.

The 35 dams control approximately one-half of the watershed and provide almost 25,800 acre feet of floodwater storage. The channel was designed with 3 : 1 side slopes and a bottom width of from 4 feet at the upper end to 10 feet at the outlet end.

For more specific information about dams and channel, see Tables 2, 3, and 3A.

BENEFITS FROM WORKS OF IMPROVEMENT

Total average annual benefit from the installation of this project will be $285,390. More intensive land use and changed land use gives an average annual benefit of $65,766. Non-agricultural water management amounts to an average annual benefit of $3,600. See Table 6.

Total flood reduction benefits amounts to an annual average of $216,024. Land treatment measures account for $9,986 of this amount.

Expected benefits have been measured for several items. On an average annual basis crop and pasture including restoration will receive $27,942; other agricultural $27,620; roads and bridges $42,044;

houses, cabins, and business $35,834. The benefit from reduction of sediment and erosion damage will be $56,907. Indirect benefits represent $25,677.

The owners of non-farm houses and business establishments will receive $35,834 average annual benefit. There are 184 owners of the non-farm houses, cabins, and business establishments receiving the benefit. There are 51 bridges and over 20 miles of road receiving benefit. The stage of the key flood at U. S. Route 50 will be reduced 1.7 feet or .3 feet below the low point of the roadway. See Table 5.

There will be a marked reduction in the damages suffered by the 132 flood plain farmers from the high frequency floods. Without the project, the floods which have a two-year frequency of occurrence inundate 2,112 acres of agricultural land. With the project installed, the flooded acreage will be reduced from 2,112 to only 165 acres. With the five-year frequency floods, the reduction will be from 3,782 acres without the project to 945 acres with the project installed.

A flood of the magnitude of the October 24, 1959, flood would cause approximately $300,000 damage without the project. With the project installed this damage will be reduced to approximately $100,000. Table 7 shows the effect of the project in greater detail by reaches.

The installation of structure #46 as a multiple-purpose structure will, in addition to providing flood protection, make available 60 million gallons (184.1 acre feet) of water for some 250 metered taps plus anticipated future needs. Many of the water wells being used at this time have an objectionably high mineral content. In addition there is a serious health hazard from the pollution of wells by seepage from septic tanks.

This flood prevention project affords exceptional possibilities for fish and wildlife enhancement. The thirty-five dams are well distributed throughout the area. As presently planned they will have a minimum water surface area of 238 acres when built. Fishing and duck hunting should greatly improve. Many site owners are already planning to build summer cabins and residences in anticipation of a greater demand for these facilities. The West Virginia Department of Natural Resources has studied sites #4, #12, #13, #15, #28, and #30 for fish and wildlife development. Every site in the watershed has a potential for multiple-purpose development. A slight increase of storage would provide excellent lakes at several sites in the sub-watershed.

Patterson Creek contributes approximately 25 percent of the total drainage area at its confluence with the North Branch of the Potomac. With 50 percent control on Patterson Creek, this would represent 12 percent control of the total area. There are no additional major tributaries until the South Branch combines with the North Branch about 7.6 miles below the confluence of Patterson and North Branch. This would provide a measurable effect on the flood stages in this 7.6 mile area. However, the results of a field investigation indicate the benefits that could be evaluated are not enough to justify the detailed analysis necessary for verification. The Potomac Basin Study has not progressed to the point that these figures are available.

COMPARISON OF BENEFITS AND COSTS

The average annual benefits from the planned structural measures are estimated to be $275,404. The annual equivalent cost including

annual operation and maintenance is $188,280, providing a favorable benefit-cost ratio of 1.5 to 1.0. Refer to Table 6 for more detail.

Calculations for operation and maintenance outlays, as well as for average annual damages and benefits, were made using long term price levels (ARS price projection, September 1957). All other cost estimates in the work plan have been based on current (1960) prices.

Only primary benefits in the immediate sub-watershed were evaluated. Other advantages such as increased recreational facilities, effects downstream from Patterson Creek, greater water conservation, and the various intangible gains naturally inherent in such a plan were not evaluated.

ACCOMPLISHING THE PLAN

This work plan is mutually agreeable to the Potomac Valley Soil Conservation District, the Fort Ashby Public Service District, and the Soil Conservation Service. While it does not obligate federal funds, it is the official document which is agreed upon by the Secretary of Agriculture and the local sponsors. This plan has a ten-year installation period, and the estimated annual obligations are as follows:

Year	Public Law 534 Land Treatment	Public Law 534 Structural	Other Land Treatment	Other Structural
1	$ 3,000	$ 941,500	$ 73,020	$ 9,900
2	3,000	472,600	73,020	12,700
3	3,000	463,400	73,020	83,400
4	3,000	747,500	73,020	18,300
5	3,000	286,300	73,020	15,900
6	3,000	329,300	73,020	15,000
7	3,000	403,100	73,020	35,100
8	3,000	393,400	73,020	15,700
9	2,900	411,000	73,020	20,800
10	2,500	354,500	73,020	8,800
Total	$29,400	$4,802,600	$730,200	$235,600

The Potomac Valley Soil Conservation District, as a legal sponsor of the project, will assume the primary local responsibility for carrying out the work plan. The District will coordinate the activities of the various cooperating agencies in order to use all the available resources most effectively for the benefit of the project. The District will encourage landowners to properly use and protect their land and will furnish technical and other assistance to cooperators as it is available.

Some of the principal responsibilities of the Potomac Valley Soil Conservation District in regard to the structural measures will be as follows:

1. Acquire in the name of the District and/or the West Virginia State Soil Conservation Committee, without cost to the Federal Government, such land, easements, and rights-of-way as will be needed for

completion of the project. The easement cost has been estimated to be $179,800. Sixteen easements with a value of $13,000 have been signed and recorded. These easements cover four sites completely. The County Court of Mineral County has agreed to provide $6,000 each year of the plan for the acquisition of easements. As required by state law, the Attorney General has approved this agreement.

2. Institute condemnation proceedings under the power of eminent domain if necessary to procure the essential land, easements, and rights-of-way.

3. Petition the Public Service Commission for permission to construct the 34 retarding dams and the multiple-purpose dam.

While the County Court of Grant County has not agreed as yet to furnish financial assistance, a proclamation of March 27, 1962, says in part: "Now, Therefore, the County Court of Grant County proclaims its approval of the aforesaid plan as explained to the County Court and realizes certain benefits will be derived by the residents of Grant County as a result of said plan being made a reality, and that, if in the discretion of the said Court the financial condition of the County is such as to permit the County Court to support and enter into a contract at a future date, every consideration to same will be given for Grant County participation;"

An official hearing was held by the Mineral County Court on Tuesday, August 8, 1961, on the formation of the Fort Ashby Public Service District. As there was considerable support for the formation of the District and no opposition, the County Court created the Fort Ashby Public Service District on its own motion and duly adopted order. The

District has the power to own and acquire property, borrow money, issue revenue bonds, and enter into contracts needed to carry out the purpose for which it was created.

Preliminary surveys and studies indicate that the cost of the entire water system, including impoundment, treatment, and distribution to the District would be approximately $348,000. On November 16, 1961, the Fort Ashby Public Service District formally applied to the Farmers Home Administration for a loan of this amount. The District understands that only the multiple-purpose structure is eligible for federal assistance under the Act and that credit assistance for the treatment and distribution system will be secured under other authorities.

The Fort Ashby Public Service District has retained a consulting engineer to advise them of the practicability of site #46 as a reservoir for municipal water. The quality of the water has been tested and found satisfactory. It has been determined that the watershed will yield the needed 60 million gallons of water. A detailed geologic examination will be made to determine the water-holding ability of the dam before design specifications are prepared. The results of the examination will be considered jointly by the Service and the consulting engineers retained by the Fort Ashby Public Service District in determining structural design detail. The cost of these examinations will be shared by the Service and the Public Service District. The consulting engineers will be primarily responsible for that part of the design dealing with water retention and facilities outletting the water to their treatment plant.

The District will acquire the land at site #46 at an estimated cost of $18,000 and pay 32.9 percent of construction and installation services. These costs are shown in Table 2. The District will also administer the contract for site #46.

The Soil Conservation Service of the U. S. Department of Agriculture, working with and through the Potomac Valley Soil Conservation District, will have the direct responsibility of furnishing technical assistance to the farmers in preparing and carrying out soil and water conservation plans.

The Soil Conservation Service will furnish plans and specifications, administer the contracts for all structural measures except #46, provide technical inspection of construction, assist with the final inspection, and pay that part of the installation cost which has been allocated to flood prevention.

The West Virginia Department of Natural Resources, in cooperation with the United States Forest Service, will furnish technical assistance to the landowners or operators for installing forest land treatment measures.

The County Agricultural Stabilization and Conservation Committees of Mineral and Grant Counties will provide cost-sharing assistance to farmers of the watershed for installation of land treatment measures in accordance with the provisions of the programs in effect at the time assistance is requested. The committees will request an additional allocation for use in the Patterson Creek Sub-Watershed.

The Farmers Home Administration will make available to eligible farm families all of the assistance available in the way of credit and

farm management guidance to establish the necessary land treatment measures. This assistance may vary over the years as the regulations pertaining to FHA loan programs are altered to meet changing conditions.

The West Virginia Cooperative Extension Service will conduct the educational phases of the watershed project through its local extension agents. The Extension Service will assist with meetings once a year, in January or February, to report progress in the watershed to date and make plans for the coming year. They have also agreed to make two or more press and radio releases annually and to investigate the possibility of television broadcasts concerning watershed project activities. They will also strive, by other means, to inform the landowners in the watershed of the over-all purpose of the project, services, and assistance provided by all agricultural agencies.

Construction of the structural measures is planned as follows:

1st year - Structures 6, 13, and 15

2nd year - Structures 10, 22, 24, 38, and 47

3rd year - Structures 12, 20, 36, and 46

4th year - Structures 27 and 41

5th year - Structures 28, 37, and 49

6th year - Structures 3, 30, 31, and 52

7th year - Structures 1, 2, and 50

8th year - Structures 14, 21, 44, 45, and channel

9th year - Structures 23, 26, 32, and 43

10th year - Structures 4, 25, and 48

The following costs will be paid from other than P. L. 534 funds:

1. The cost of installation of land treatment measures to the open land amounts to $654,000.

2. The cost of applying land treatment measures to forest land, estimated to be $76,200.

3. The cost of providing the land, easements, and rights-of-way estimated to be $179,800. This cost includes $5,900 easement cost allocated to municipal water.

4. The construction cost share of structure #46 allocated to municipal water, estimated to be $42,900.

5. The share of the installation services of structure #46 for municipal water, estimated to be $12,900. This cost includes $200 for administering contract.

6. The estimated annual cost of maintenance of the structural measures, estimated to be $6,200.

Substantial contributions will be made to the program during and after the ten-year installation period by the Agriculture Conservation Program, Soil Bank Program, Clarke-McNary Act, and Cooperative Forest Management Act.

The following costs will be paid from P. L. 534 funds:

1. The cost of providing the technical assistance for installing the land treatment measures on open land, estimated to be $11,300.

2. The cost of providing the technical assistance for installing the land treatment measures on forest land, estimated to be $18,100.

3. The installation cost of structural measures allocated to flood prevention, estimated to be $4,802,600.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures for the open land will be maintained by the landowners or operators of the farms on which these measures are installed. This maintenance work will be done in accordance with the terms of the Farmer-District Cooperative Agreement. The Soil Conservation Service working through the Potomac Valley Soil Conservation District will continue to furnish technical assistance to landowners after the installation period of this project.

Forest land treatment measures will be maintained by the landowners or operators of the land on which the measures are installed. Technical assistance will be furnished by the West Virginia Department of Natural Resources in cooperation with the United States Forest Service.

The Potomac Valley Soil Conservation District is responsible for the maintenance of all the structural measures except structure #46. The District has negotiated a supplemental agreement with the State Road Commission of West Virginia whereby the latter agency will perform the required maintenance for all the structural measures except #46. This agreement has been signed by the State Road Commission and returned to the District. These annual maintenance costs are as follows:

$100 each for retarding structures 24, 27, 36, 45, 47, and 52

$150 each for retarding structures 1, 2, 3, 14, 20, 22, 23, 25, 26, 28, 30, 31, 32, 37, 38, 43, 44, 48, and 49

$200 each for retarding structures 4, 6, 10, 12, 13, 21, and 50

$400 for retarding structure 15

$500 for retarding structure 41

$250 for channel improvement

The Fort Ashby Public Service District will be responsible for the operation and maintenance of structure #46. The annual maintenance cost will be $200.

The total annual maintenance cost of the structural measures is estimated to be $6,200.

The Potomac Valley Soil Conservation District and the Fort Ashby Public Service District for #46 only will execute an operation and maintenance agreement with the Soil Conservation Service providing for operation and maintenance of the structural works of improvement. These agreements will be executed prior to the issuance of an invitation to bid. They will give the details of inspections, records, and reports. The concerned sponsoring local organizations will be responsible for operation and maintenance upon receipt of a notice from the Soil Conservation Service that structural works of improvement have been accepted from the contractor.

Structural works of improvement will be jointly inspected by the concerned sponsoring local organization and a representative selected by the State Conservationist. These inspections will be made annually and also after every major storm or other occurrence that might adversely affect the structures. A written report of these inspections with recommendations will be made by the Service representative to the State Conservationist.

CONFORMANCE OF PLAN TO FEDERAL LAWS AND REGULATIONS

This plan for the Patterson Creek Sub-Watershed conforms to all federal laws and regulations and will have no known detrimental effect on any existing project or any project that might be constructed in the future. This proposed project will not bring any new land into production.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Patterson Creek Sub-Watershed, West Virginia

Installation Cost Item	Unit	Number Non-Fed. Land	Estimated Cost (Dollars) 1/ P. L. 534 Funds	Other	Total
Land Treatment					
Soil Conservation Service					
Pasture and Hayland Renovation	Ac.	11,000	0	397,500	397,500
Proper Pasture Use	Ac.	11,000	0	23,100	23,100
Subsoiling	Ac.	5,000	0	27,500	27,500
Hayland Planting	Ac.	4,000	0	195,600	195,600
Technical Assistance	--	--	11,300	10,300	21,600
SCS Subtotal	--	--	11,300	654,000	665,300
Forest Service					
Tree Planting	Ac.	750	0	26,850	26,850
Hydrologic Cultural Operations	Ac.	2,000	0	16,550	16,550
Woodland Grazing Control	Mi.	15	0	14,700	14,700
Technical Assistance	--	--	18,100	18,100	36,200
FS Subtotal	--	--	18,100	76,200	94,300
TOTAL LAND TREATMENT	--	--	29,400	730,200	759,600
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	--	34	3,722,500	0	3,722,500
Stream Channel Improvement	Ft.	4,497	4,400	0	4,400
Multiple-Purpose Structure	--	1	87,600	42,900	130,500
Subtotal Construction	--	--	3,814,500	42,900	3,857,400
Installation Services					
Soil Conservation Service					
Engineering Services	--	--	700,400	9,200	709,600
Other	--	--	280,800	3,500	284,300
Subtotal Installation Services		--	981,200	12,700	993,900
Other Costs					
Land, Easements & R/W	--	--	0	179,800	179,800
Administering Contracts	--	--	6,900	200	7,100
Subtotal Other Costs	--	--	6,900	180,000	186,900
TOTAL STRUCTURAL MEASURES	--	--	4,802,600	235,600	5,038,200
TOTAL PROJECT	--	--	4,832,000	965,800	5,797,800
Summary					
Subtotal SCS	--	--	4,813,900	889,600	5,703,500
Subtotal FS	--	--	18,100	76,200	94,300
TOTAL PROJECT	--	--	4,832,000	965,800	5,797,800

1/Price base 1960

April 1962

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Patterson Creek Sub-Watershed, West Virginia

(Dollars) 1/

Str. Site No.	Installation Cost - P. L. 534 Funds: Construction	Instal. Services: Engineering	Instal. Services: Other	Total P. L. 534	Installation Cost - Other Funds: Easements and Rights-of-Way		Total Installation Cost
1	97,100	23,400	9,000	129,500	3,000		132,500
2	80,200	19,400	7,400	107,000	4,700		111,700
3	87,700	21,200	8,200	117,100	11,100		128,200
4	170,200	24,300	11,800	206,300	3,100		209,400
6	146,600	26,800	11,800	185,200	1,300		186,500
10	140,000	25,600	11,300	176,900	1,800		178,700
12	175,700	25,100	12,200	213,000	6,300		219,300
13	229,400	30,700	13,600	273,700	1,300		275,000
14	70,700	17,100	6,500	94,300	5,400		99,700
15	414,200	46,400	22,200	482,800	7,300		490,100
20	64,600	15,600	6,000	86,200	1,600		87,800
21	131,400	24,000	10,600	166,000	6,000		172,000
22	86,800	21,000	8,000	115,800	7,400		123,200
23	89,200	21,500	8,300	119,000	6,600		125,600
24	34,900	9,100	3,300	47,300	1,100		48,400
25	53,900	14,100	5,000	73,000	4,000		77,000
26	69,300	16,700	6,500	92,500	2,400		94,900
27	46,800	12,300	4,300	63,400	2,400		65,800
28	77,600	18,700	7,200	103,500	7,100		110,600
30	52,500	12,700	4,900	70,100	1,100		71,200
31	72,700	17,600	6,800	97,100	1,200		98,300
32	76,800	18,500	7,100	102,400	5,600		108,000
36	37,400	9,800	3,400	50,600	1,700		52,300
37	73,400	17,700	6,800	97,900	2,400		100,300
38	72,200	17,400	6,600	96,200	1,200		97,400
41	592,700	62,800	28,600	684,100	15,900		700,000
43	72,700	17,600	6,800	97,100	6,200		103,300
44	54,700	14,300	5,100	74,100	2,600		76,700
45	39,200	10,300	3,700	53,200	1,400		54,600
46	87,600	18,900	6,900	113,400	18,000	55,800 2/	187,200
47	26,900	7,000	2,500	36,400	1,200		37,600
48	56,400	13,600	5,200	75,200	1,700		76,900
49	63,600	15,400	5,900	84,900	6,400		91,300
50	131,800	24,100	10,700	166,600	27,400		194,000
52	33,200	8,700	3,100	45,000	1,600		46,600
Ch. Imp. (4,497')	4,400	1,000	400	5,800	300		6,100
GRAND TOTAL	3,814,500	700,400	287,700 3/	4,802,600	179,800	55,800	5,038,200

1/ Price base 1960

2/ $42,900 for construction, $9,200 for engineering services, $200 for administering contract, and $3,500 for other installation services.

3/ Includes $6,900 for administering contracts.

April 1962

TABLE 3 - STRUCTURE DATA

FLOODWATER RETARDING STRUCTURES AND WATER SUPPLY RESERVOIR

Patterson Creek Sub-Watershed, West Virginia

[illegible]	[illegible]	[illegible]	[illegible]	3	[illegible]	6 2/	10 3/	12	13	14	15	[illegible]	21	22	23	24	25	26	27	28	30	31	32	36	37	38	41	43	44	45	46	47	48	49	50	52	Total
[illegible]	[illegible]	[illegible]	[illegible]	2.69	7.73	2.10	3.70	8.74	6.88	1.55	17.81	1.56	5.25	2.92	2.56	1.11	1.12	1.66	1.14	6.56	1.53	2.34	3.44	0.97	2.96	3.40	27.89 4/	1.93	1.21	0.56	1.76	0.69	1.67	2.27	11.03	0.98	139.64
[illegible]																																					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	47.7	[illegible]	119.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	34.2	41.0	15.5	47.5	[illegible]	258.2	34.1	23.0	11.2	31.3	11.2	31.0	42.6	163.4	16.7	1997.2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	549.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1182.2	[illegible]	[illegible]	606.1	136.5	575.8	553.8	4908.0	319.5	220.7	87.0	344.7	84.7	312.0	310.5	2024.2	135.3	25,806.6
[illegible]	[illegible]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	184.1	—	—	—	—	—	184.1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1293.9	[illegible]	[illegible]	280.5	[illegible]	596.4	[illegible]	[illegible]	187.2	[illegible]	[illegible]	1261.3	[illegible]	450.5	[illegible]	152.0	623.3	605.6	5166.2	353.6	243.7	98.2	560.1	95.9	343.0	353.1	2187.6	152.0	27,987.9
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	67.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	297.3	[illegible]	[illegible]	[illegible]	44.1	134.1	[illegible]	892.4	87.3	96.5	45.0	140.9	31.2	75.9	60.4	500.2	44.6	5797.6
[illegible]																																					
[illegible]	[illegible]	[illegible]	[illegible]	7.1	10.7	3.1	5.6	11.5	9.8	3.1	19.0	3.7	9.2	6.7	4.8	3.3	3.4	4.3	3.1	13.4	2.8	4.8	5.9	2.8	6.7	7.0	22.0	4.3	4.6	2.2	3.8	2.1	5.0	6.7	17.4	3.2	238.5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	55.2	29.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	78.5	14.7	[illegible]	35.0	12.5	40.3	34.7	160.8	20.1	19.8	8.9	25.5	10.2	20.7	29.7	106.2	13.7	1322.4
[illegible]	[illegible]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13.9	—	—	—	—	—	13.9
[illegible]	[illegible]	[illegible]	[illegible]	128.3	253.3	218.2	208.3	275.2	341.3	98.5	672.3	82.4	195.4	124.9	130.5	38.5	67.7	95.2	57.2	110.0	67.0	101.4	108.9	42.3	102.3	100.7	962.2	101.4	70.7	43.7	155.2	26.1	70.0	87.4	196.2	34.8	5625.6
[illegible]	[illegible]	[illegible]	[illegible]	1146.4	1156.5	1761.8	1697.7	1004.2	1043.3	934.6	923.3	991.7	984.1	841.3	988.0	784.4	763.4	782.1	750.3	848.4	820.6	747.7	745.4	741.2	738.3	730.3	1145.5	905.9	670.1	660.5	747.6	826.1	937.0	1170.7	667.3	750.7	XXX
[illegible]	[illegible]	[illegible]	[illegible]	43.4	68.5	71.8	60.7	74.2	86.3	56.6	85.3	53.7	64.1	54.3	55.0	36.4	41.4	47.1	39.3	43.4	50.6	49.7	53.4	38.2	46.3	51.3	90.5	55.9	35.1	32.5	65.6	31.1	49.0	37.7	58.3	33.7	XXX
[illegible]																																					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	730.4	722.0	1131.2	897.4	665.0	654.4	738.7	820.5	927.0	1165.2	658.8	744.1	XXX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	150	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15	[illegible]	80	[illegible]	120	400	100	400	100	150	100	80	400	300	50	XXX
[illegible]		[illegible]	[illegible]	S.Sh.	S.Sh.	S.Sh.	H.Sh.	S.Sh.	H.Sh.	S.Sh.	H.Sh.	S.Sh.	H.Sh.	Clay	S.Sh.	Clay	S.Sh.	S.Sh.	Clay	Clay	Clay	S.Sh.	S.Sh.	S.Sh.	S.Sh.	S.Sh.	Rock	S.Sh.	Clay	Clay	S.Sh.	Clay	H.Sh.	Clay	S.Sh.	Clay	XXX
[illegible]		[illegible]	[illegible]	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	XXX
[illegible]		[illegible]	[illegible]	75	74	73	64	75	70	74	75	75	74	74	63	75	75	75	75	73	72	67	75	74	74	73	64	74	74	74	74	73	73	75	73	73	XXX
[illegible]																																					
[illegible]	[illegible]	[illegible]	15.30	15.27	9.68	15.40	15.10	9.57	9.80	10.34	13.57	15.51	14.84	10.11	15.36	10.45	15.68	15.50	10.45	9.79	10.34	15.37	15.10	15.72	10.14	10.08	13.04	15.44	15.65	15.91	15.51	10.57	15.51	10.24	9.41	10.49	XXX
[illegible]	[illegible]	[illegible]	14.05	14.15	8.47	14.15	12.74	8.48	8.21	9.12	12.46	14.39	13.59	8.99	13.00	9.36	14.56	14.38	9.36	8.57	8.99	13.45	13.98	14.46	8.92	8.74	10.73	14.19	14.39	14.65	14.25	9.22	14.12	9.15	8.07	9.14	XXX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9.7	[illegible]	[illegible]	[illegible]	[illegible]	9.7	9.9	9.4	11.2	[illegible]	11.1	10.4	10.9	15.0	11.3	7.5	8.8	11.0	8.2	13.2	8.0	10.6	9.5	XXX
[illegible]	[illegible]	[illegible]	7,235	8,200	9,600	11,900	10,770	13,100	8,870	2,800	31,900	6,660	13,150	4,550	5,300	2,803	4,590	5,200	1,980	7,845	2,880	7,150	10,400	3,880	3,850	5,300	43,100	5,050	5,575	2,400	6,620	1,938	6,600	6,810	11,740	1,590	XXX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	846.3	[illegible]	745.2	742.9	738.9	735.9	728.0	1141.8	903.8	668.1	658.5	744.8	824.1	935.0	1168.7	664.5	748.7	XXX
[illegible]																																					
[illegible]	[illegible]	[illegible]	[illegible]	25.45	16.93	25.70	25.10	16.75	17.10	18.10	22.60	25.88	24.75	17.70	25.60	18.29	26.13	25.83	18.29	17.13	18.10	25.60	25.20	26.20	17.75	17.64	21.73	25.73	26.08	26.52	25.85	18.50	25.85	17.92	16.47	18.36	XXX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14.82	[illegible]	14.15	20.50	21.55	22.41	14.15	13.87	16.15	21.95	22.30	22.65	22.07	14.70	21.88	14.46	12.74	14.57	XXX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.9	11.2	13.2	13.9	13.3	12.7	13.1	17.4	13.3	8.9	10.6	13.3	9.8	15.3	10.1	13.3	11.4	XXX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,900	11,700	17,880	6,850	7,400	9,450	69,800	9,300	9,200	4,100	12,050	3,205	10,600	13,300	22,980	2,830	XXX
[illegible]	[illegible]	[illegible]	1185.8	1146.4	1156.5	1761.7	1697.7	1004.2	1043.3	934.6	923.3	991.7	984.1	841.3	987.5	784.2	763.4	782.1	750.3	848.4	820.3	747.7	745.4	741.2	738.3	730.3	1145.5	905.9	669.2	660.1	747.2	825.4	937.0	1170.5	667.3	750.6	XXX
[illegible]																																					
[illegible]	[illegible]	[illegible]	9.1	8.9	23.6	8.3	17.0	34.2	27.8	8.4	83.9	8.0	24.6	18.0	13.2	6.6	6.7	7.3	6.9	29.8	8.5	11.9	18.3	7.1	16.3	17.6	115.5	8.2	7.5	7.5	14.3	6.4	9.0	8.9	48.5	6.4	XXX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	70.8	119.0	64.9	66.9	121.5	693.1	73.0	68.3	66.1	73.6	62.0	70.0	115.1	272.0	61.9	XXX
[illegible]																																					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.26	0.26	0.24	0.28	0.33	0.33	0.21	0.36	0.24	0.30	0.25	0.31	0.36	0.32	0.29	0.23	0.29	0.27	0.22	0.30	0.30	0.29	0.17	0.33	0.36	0.37	0.33	0.31	0.35	0.35	0.28	0.32	XXX
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.73	[illegible]	3.30	[illegible]	3.75	3.05	3.30	3.11	3.43	2.90	3.67	2.31	3.49	2.57	3.44	2.58	XXX
[illegible]	[illegible]	[illegible]	[illegible]	2.36	1.33	1.19	1.83	1.38	1.61	1.55	2.11	2.06	3.39	1.47	1.55	2.03	2.31	2.25	1.93	1.82	1.36	2.31	2.07	2.57	2.32	1.80	1.76	1.92	1.65	2.07	2.76	1.92	2.60	1.49	1.71	2.08	XXX
[illegible]		[illegible]	[illegible]	c	b	c	c	b	b	b	c	c	c	b	c	b	c	c	b	b	b	c	c	c	b	b	c	c	c	c	c	b	c	b	b	b	XXX

[illegible]

March 1962

TABLE 3A - STRUCTURE DATA

Patterson Creek Sub-Watershed, West Virginia
Channel

Sta. numbering for reach		Water-shed Area	Planned Channel Capacity 2/	Average Bottom Width	Average Side Slope	Average Depth	Average Grade	Average Velocity in 3/ Channel	Volume of Excavation
Sta.	Sta.								
(100 ft.)	(100 ft.)	(sq.mi.)	(cfs)	(ft.)	--	(ft.)	(percent)	(ft. per sec.)	(1,000 cu.yds.)
1/ 0+00	1+60	0.17	47	4.0	3 : 1	2.1	.563	2.17	.08
1+60	11+00	0.17	47	6.0	3 : 1	2.6	.223	1.31	1.13
11+00	44+97	0.62	100	10.0	3 : 1	2.9	.094	1.84	1.53
								Total Excavation	2.74

1/ Section 0+00 - 1+60 is a transition section with bottom width of channel at station 0+00 approximately 2' increasing to 6' at station 1+60.

2/ Design flow of channel is based on flow from the uncontrolled area and release from floodwater detention dams #44 and #45 for the 15-year event.

3/ From water surface profile computations.

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TABLE 4 - ANNUAL COST

Patterson Creek Sub-Watershed, West Virginia

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
1	24,326	800	25,126
2	38,496	900	39,396
3	17,864	400	18,264
4	55,858	2,050	57,908
5	26,794	1,150	27,944
6	18,742	900	19,642
TOTAL	182,080	6,200	188,280

1/ Price base current (1960) for installation; long term projected - ARS price projection Sept. 1957 for operation and maintenance.

2/ Fifty year period at 2-5/8% interest.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Patterson Creek Sub-Watershed, West Virginia

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Floodwater			
Crop and Pasture	39,350	11,408	27,942
Other Agricultural	36,768	9,148	27,620
Roads and Bridges	55,907	13,863	42,044
Houses,Cabins, and Businesses	53,357	17,523	35,834
Subtotal	185,382	51,942	133,440
Sediment			
Overwash	57,514	13,384	44,130
Swamping	8,649	3,477	5,172
Subtotal	66,163	16,861	49,302
Erosion			
Scour	8,703	1,098	7,605
Indirect	35,396	9,719	25,677
Total	295,644	79,620	216,024

1/ Price base long term projected - ARS price projection September 1957.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Patterson Creek Sub-Watershed, West Virginia

(Dollars) 1/

Evaluation Unit	AVERAGE ANNUAL BENEFITS					Ave. Annual Cost	Benefit Cost Ratio
	Flood Prevention			Nonagricultural Water Mgt.	Total		
	Damage Reduction	More Intensive Land Use	Changed Land Use Urban				
No. 1	46,542	11,335	5,230	--	63,107	25,126	2.5 to 1.0
No. 2	29,813	8,133	2,377	--	40,323	39,396	1.0 to 1.0
No. 3	27,552	7,650	2,672	--	37,874	18,264	2.1 to 1.0
No. 4	61,725	14,358	6,842	--	82,925	57,908	1.4 to 1.0
No. 5	22,509	3,783	1,914	--	28,206	27,944	1.0 to 1.0
No. 6	17,897	894	578	3,600	22,969	19,642	1.2 to 1.0
GRAND TOTAL	206,038	46,153 2/	19,613	3,600	275,404	188,280	1.5 to 1.0

1/ Price base - long term projected - ARS price projection September 1957

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $9,986 annually.

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TABLE 7 - PROJECT BENEFIT BY REACH

Patterson Creek Sub-Watershed, West Virginia

Reach	Present Conditions							Future Conditions						
	Acres Drainage Area at Foot of Each Reach	Peak Flow 100-Yr. c.f.s.	Peak Flow Key Flood c.f.s.	Acres Inundated 2-Yr.	Acres Inundated 5-Yr.	Key* Flood Damage	Ave. * Annual Damage	Acres Controlled at Foot of Each Reach	Peak Flow 100-Yr. c.f.s.	Peak Flow Key Flood c.f.s.	Acres Inundated 2-Yr.	Acres Inundated 5-Yr.	Key * Flood Damage	Average * Annual Damage
A	181,248	24,200	11,300	165	167	2,426	1,540	89,365	15,000	6,500	0	96	820	386
B	175,171	23,500	11,200	93	98	1,866	1,260	89,365	14,300	6,400	18	92	910	370
C	166,591	22,500	11,100	289	946	61,299	19,605	89,365	13,100	6,100	29	233	7,580	4,068
D	153,374	21,000	10,700	10	44	8,864	4,809	80,045	12,100	5,700	4	8	3,500	1,280
E	145,222	20,000	10,550	152	206	22,485	13,188	80,045	11,200	5,600	0	99	9,500	3,488
F	126,301	17,200	9,440	351	449	17,400	8,699	71,166	9,800	5,000	9	44	8,100	2,427
G	106,617	15,000	8,900	634	787	22,205	8,275	65,238	8,200	4,500	4	123	6,900	1,538
H	84,256	12,200	7,380	178	390	43,664	17,739	57,745	5,700	3,250	22	113	15,680	3,490
I	62,422	9,500	5,500	66	334	10,357	4,741	41,693	4,250	2,450	2	4	4,520	1,044
J	55,772	8,700	5,000	81	128	6,904	3,453	39,632	3,700	2,050	37	66	3,265	844
K	41,836	6,500	3,735	68	109	4,012	2,164	29,637	2,800	1,610	24	42	2,400	684
L	20,341	7,900	2,400	0	0	3,779	2,066	11,790	3,600	1,060	0	0	720	478
M	12,805	5,100	1,555	25	92	6,065	3,888	6,840	2,700	780	20	25	2,800	1,445
N	7,103	3,450	905	0	32	11,289	9,638	5,118	1,330	340	0	0	400	1,791
Cabin Run 1	14,768	3,550	1,350	--	--	10,263	5,174	8,879	1,490	575	--	--	5,400	1,563
Cabin Run 2	6,675	2,980	1,037	--	--	7,837	4,069	5,175	800	290	--	--	680	485
Mill Ck. 2	14,559	5,500	2,250	--	--	8,164	2,959	4,359	3,850	1,500	--	--	3,900	1,166
Mill Ck. 3	12,359	4,650	1,775	--	--	6,531	2,468	3,363	1,600	610	--	--	2,000	461
Staggs	4,155	1,680	559	--	--	4,059	2,039	1,233	1,100	365	--	--	2,550	1,014
Elliber	2,048	1,250	178	--	--	2,799	2,927	1,638	365	54	--	--	0	403
Painter	2,952	1,450	268	--	--	25,191	16,652	1,127	950	180	--	--	13,300	9,703
Mill Race	1,406	850	165	--	--	4,292	3,432	1,132	205	44	--	--	0	253
North Fork	13,773	4,050	940	--	--	8,024	5,135	3,711	2,680	560	--	--	6,800	2,817
TOTAL	--	--	--	2,112	3,782	299,775	145,920	--	--	--	169	937	101,725	41,198

* Dollars long term projected - ARS price projection Sept. 1957 - not including crop, sediment, erosion, or indirect damages.

March 1962

INVESTIGATIONS AND ANALYSES

The local organizations, through their various committees, contributed the basic information of need and desires reflected in the plan. There were some forty members of six committees participating in the development of the plan through numerous meetings, reports, and field trips.

It was evident from the early evaluations that the original 23 retarding structures would not afford the protection desired by the local people. The local people wanted protection for their farm land from the frequent floods. (See Table 7 for the reduction in the various reaches of flooding by the 2 and 5-year floods). Accordingly, a project of 35 floodwater retarding dams with 2-stage outlets was planned.

The Soil Conservation Service, in assisting the sponsoring organizations, employed the following data, sources, methods, and procedures in the preparation of this plan.

Hydrologic and Hydraulic Investigations

The hydrologic and hydraulic investigations of this watershed were complicated by the length - width ratio of 5.5 to 1 and the flooding problem being a combination of agricultural or frequent storm damage and scattered urban or larger storm damage. In order that the structure location and proportioning system would be adequate to establish sound conclusions in terms of conditions, objectives, and functions of the project, the following procedures were used.

One United States Geologic Survey stream gage station with eighteen years of record is located in the lower one-fourth of the watershed. This was considered insufficient for establishing discharge-frequency relationships. However, this record was used to check the accuracy of the hydraulic procedures by routing two historical events and comparing the routed and gage hydrographs.

There were no precipitation gages within the watershed. Eight precipitation gages, two of which were recording, near the perimeter of the watershed were used to construct isohyetal maps for the two historical storms.

A synthetic storm series was developed from rainfall data taken from the U. S. Weather Bureau Technical Paper 29 (TP-29). Three storms of varying magnitude were selected from this series for flood routing in addition to two historical storms (one being the key storm).

A soil cover complex number for each subarea was calculated as outlined in the Soil Conservation Service National Engineering Handbook (NEH-4). The hydrologic soil grouping and cover for open land was developed by the Work Unit Conservationist from a complete soils map and use data of the portion of the watershed in each county. The data for the woodland areas was developed by the U. S. Forest Service.

The runoff for the historical storms was determined by using gage rainfall and the hydrologic curve number corresponding to the five-day antecedant moisture condition. The runoff for the synthetic storms was determined by using the rainfall from TP-29 and the hydrologic curve number for moisture condition II. Runoff hydrographs were prepared for each subarea using the formula $q = \frac{484\ AQ_x}{T_p}$. T_p was computed from the formula $T_p = \frac{D}{2} + .6\ T_c$, and D (duration) used was equal to 24 hours for the main stem synthetic storms and the actual duration as determined from the recording gages was used for the historical routings. The duration for computing subarea hydrographs to be used for tributary analysis was determined by the travel time of the tributary in question. The time of concentration (T_c) was based on stream hydraulics.

The hydrographs were routed by the Wilson Graphical Method as outlined in NEH-4. The routed peaks for each reach were modified for land treatment

effect as outlined in NEH-4. The subarea hydrographs were modified for land treatment effect and combined with outflow from the structures and re-routed to show structure effect.

Seven complete routing evaluations were made using different numbers of structures, different release rates, and different combinations of first and second stage storage. An evaluation was made with all structures single stage. This combination gave relatively little protection from the small storms. An evaluation was made with all two-stage structures and a minimum of four inches of runoff controlled. This combination was too costly in relation to benefits derived. An evaluation was made using SCS Technical Release No. 10 (TR-10) to set first and second stage storage using all two-stage structures. This evaluation gave the most desirable combination from a benefit comparison.

Separate evaluations were made in the Fort Ashby area relative to the existing millrace. Evaluations included channel only and channel plus two retarding structures. The combination of channel and two retarding structures gave the maximum benefits.

The selected project was based on all structures being two-stage with sufficient storage in the first stage to offset the overflow hydrographs enough to prevent addition of pipe flow at the peak of the 10-year hydrograph. This storage was released in eight to ten days. The storage in the second stage was determined by TR-10 using the accumulated 100-year rainfall as taken from TP-29 for both hazard class "c" and "b." Pipe sizes were selected to empty this storage within 100 hours.

These routed peak flows were plotted on log-normal paper to give discharge-frequency curves for present conditions, with land treatment, and with land treatment plus structural measures for each reach.

Stage-discharge relationships were established by computing water-surface profile by the Step Method as outlined in NEH-4 for main stem sections. The tributary sections were computed by using Manning's open channel formula.

Area inundation calculations for each reach were based on flood plain acreage from aerial photos and one or more typical flood plain sections for each reach. The aerial photos were planimetered to get the flood plain acreage in each reach. The acreage for the 50, 25, 10, 5, and 2-year inundation was calculated by multiplying the total flood plain acreage by the ratio of the corresponding width and the 100-year width measured at the proper elevation on the typical section. Area inundation by stage was calculated by the same method.

Flood distribution by month was based on information obtained from data developed in the Ohio Basin and monthly distribution of rainfall from TP-29. The Ohio information gave the breakdown on percent flooding in growing and non-growing season by size of drainage area. These two percentages were further broken down by month by using the monthly rainfall distribution in TP-29.

Design inflow hydrographs for the 35 structures were prepared in accordance with state criteria for West Virginia, and Engineering Memo SCS-27. The spillway design hydrographs for class "b" structures were based on the runoff produced from 1.0 times the maximum expected six-hour-point rainfall, moisture condition III and for class "c" 1.5 times six-hour-point rainfall, moisture condition III. The freeboard hydrographs class "b" and "c" were based 1.75 and 2.5 times the maximum expected six-hour-point rainfall, moisture condition II, respectively.

The capacity of the improved millrace channel was based on the peak flow from a 15-year storm. Any storm larger than the 15-year event with the project will inundate this benefitted area with overflow from the main channel of Patterson Creek.

Peak flow from the uncontrolled area was computed using the formula $q = \frac{484\ AQx}{T_p}$. The outflow from structures 44 and 45 was added to the uncontrolled peak flow to determine design capacity.

The required channel depth was determined by computing water-surface profile by the Step Method using the design capacity and widths selected by Manning's equation.

Geologic Investigations

A bottomland survey was made by the range method. There were a minimum of two ranges in the short reaches and a maximum of four ranges in the longer reaches. These were summarized for each reach according to percent damage. The area flooded for each reach was established by planimetering 660 scale aerial photos of the flood plain as described previously under Hydrologic and Hydraulic Investigations.

Erosion damage reductions were based on the beneficial effects of the revised land treatment and the structural measures. Overwash damage reduction was computed on the basis of reductions of area inundated in accordance with reductions in frequency of flooding expected from the structural measures.

Scour damage reductions were based on reduction of area inundated and reduction of scouring forces resulting from reduced flood stages and frequency of flooding. Swamping damage was considered to be related to these causes: swamping resulting from overwash deposits, swamping caused

by scour, and swamping not related to flood flows. Reduction in swamping damage was computed in the same manner as reduction of its various related causes were computed. Swamping not related to flood flows was considered as a part of the remaining damages.

The installation of the structures in this project will make it possible for the farmers to successfully install tile and open drains. In this manner, there will be a further reduction in swamping than that shown in Table 5.

The sediment storage requirements for the floodwater retarding structures were computed for a fifty-year period by procedures outlined in the Geology Section of the Watershed Planning Guide. Factors taken into consideration are the total soil loss, delivery rate to the structure, channel erosion, and the trap efficiency of the reservoir.

Preliminary geologic investigations were made on each of the proposed impoundment sites. No adverse geologic problems were encountered. Adequate borrow material for the structures is available within a reasonable distance of each site. Depth to bedrock along the centerlines will vary from three feet in the smaller structures to twenty feet in the larger. All principal spillways will be on unyielding foundations, and emergency spillways will be of the side hill type.

Patterson Creek is a north flowing subsequent stream in the Valley and Ridge province. It is flanked on the west by the Wills Mountain anticline and on the east by the Patterson Creek anticline. The majority of the sites are on the west side of the main stream and all are located in the Middle and Lower Devonian formations. Generally the abutments have a thin mantle of residual soil over interbedded thin sandstones

and shales. The alluvium varies in depth according to the size of the drainage area. Emergency spillways will be located in the bedrock formations.

The borrow will be shale and thin sandstone from the emergency spillway cuts, sandy and gravelly clays from Pleistocene terrace remnants, and poorly graded sands and gravels from the flood plain alluvium. The amounts of clay will vary in the alluviums and shales according to formations. Wet excavations can be expected at some locations.

A detailed site investigation will be made at each site prior to final design of the structure.

Economic Investigations

In general the economic investigations were made as suggested and outlined in the Economics Guide of December 1958, prepared by the Soil Conservation Service, Washington, D. C.

The basic information on flood damages was obtained in the field from personal interview with over three hundred property owners. Most of this information is related to the flood of October 24, 1959. At the time this damage information was recorded appraisals were made of damages at higher and lower stages than occurred during the event of October 24, 1959. A study was made of road and bridge damage. Road officials supplied information they had available. Over 20 miles of road and 45 bridges and culverts are subject to damage. Separate stage damage data was set up for each reach. Damages and benefits for these may be found in Table 5 of this plan. These estimates were tabulated by stages and converted to long-term prices using Agricultural Price and Cost Projections published September 1957 by ARS and AMS.

All costs to be incurred during the 10-year installation period of the project were based on the 1960 price level. Easements costs were developed by working with the local easement committee. Each structure site was visited numerous times and analyzed by the committee. Tabulation was made for each site by ownership of the expected cost and/or value of easement.

Floodwater damages and benefits were computed using the frequency method as described in Chapter 3 of the Economic Guide, Soil Conservation Service. Separate damage frequency relationships were developed for thirty-three reaches.

Enhancement expected in each of five areas was developed with the assistance of the local people. These areas are located in the lower portion of the watershed. One area is some 154 acres along the stream between Fort Ashby and the mouth of Patterson Creek. Another 131 acres is immediately above Fort Ashby. A third area is 175 acres just below Route 50. The millrace area of 160 acres along a tributary stream at Fort Ashby is expected to increase in value with flood protection; and the fifth area is 65 acres along Painter Run, another stream at Fort Ashby. This enhancement represents the immediate increase in value of land along the stream once the project is installed. Primary use of the areas along Patterson Creek will be for cabins, recreation, beach development, etc. The two areas on tributaries at Fort Ashby will be developed to more urban use.

Per Acre Land Values (Dollars)

Reach	Present	Future	Benefit
A	800	1600	979
B	800	1600	1780
C	800	1600	3024
D	800	1600	890
E	800	1600	4007
G	800	1600	6498
Millrace	300	500	1452
Painter	500	825	983

To determine land damage; i.e. overwash, scour, and swamping, a dollar value was placed on the loss in net income by using composite net income data for each reach. The flood plain acreage was considered in three categories: (1) tilled land presently in productive agricultural use, (2) untilled land but suitable for tillage, (3) other land of non-agricultural use. All land damage claimed is occurring on the land described under (1).

Restoration benefits were determined for the flood plain acres of Patterson Creek. A summary of such benefits is as follows:

PRESENT WITHOUT PROJECT

Crop	Yield/Acre 1/	Acres	Net Income
Corn	100 bu.	838.9	$60,820
Hay	3 ton	1,886.3	69,793
Grain	65 bu.	201.1	7,650
Pasture	4.5 AUM	2,685.9	110,793
Idle	--	82.7	--
Other	--	1,477.1	--
Total	--	7,172	$249,056

1/ Flood-free yield under present levels of management. Thus more intensive use of land is not included.

WITH PROJECT

Crop	Yield/Acre 1/	Acres	Net Income
Corn	100 bu.	1,115	$ 80,838
Sweet Corn	900 doz.	70	16,328
Hay	3 ton	1,402	51,874
Grain	65 bu.	200	7,608
Pasture	4.5 AUM	2,430	100,238
Other	--	1,955	--
Total	--	7,172	$256,886

1/ Flood-free yield under present levels of management. Thus more intensive use of land is not included.

The difference in net income discounted for a time lag of five years, reduced for added flood damages, and reduced for the development costs amortized leaves $6,811 average annual for restoration.

More intensive use benefits have been determined as benefits in addition to the restoration benefits. With project installation the flood plain will be farmed at a more intensive level giving higher yields than those listed in the previous table. With higher yields the net income would be as follows:

WITH PROJECT

Crop	Yield/Acre	Acres	Net Income
Corn	100 bu.	275	$19,938
Corn	115 bu.	840	74,214
Sweet corn	1,000 doz.	70	18,200
Hay	3.5 ton	927	41,714
Hay	4.0 ton	475	34,675
Grain	70 bu.	200	6,400
Pasture	5.0 AUM	930	43,013
Pasture	5.5 AUM	1,500	76,875
Other	--	1,955	--
Total	--	7,172	$315, 029

The difference of $58,143 in net income discounted for ten years and reduced for added flood damage leaves $46,153 as more intensive use benefit.

Numerous alternatives were considered in developing the desired project. Routings were made of different structures and of different release rates to determine the more desirable combination. Seven evaluations were made to determine the reduction in damage or benefit. Indirect damage and benefit was added to each reach by the following rule: 10% of

crop and pasture and other agricultural plus 15% of restoration plus 20% of houses, cabins, businesses,plus 30% of road and bridge. Total benefit for each reach was then distributed to the structures above that reach in direct relation to the reduction each structure made in total reduction of peak discharge.

Thirty-five floodwater retarding structures were grouped into six evaluation units because of the location of damages and damage reaches. The structures within each unit are interrelated measures producing benefits common to the group. The absence of any one structure reduces the protection below the desirable level. The groups of structures are as follows:

Evaluation Unit	Structural Measures
No. 1	1, 2, 3, 4, and 49
No. 2	6, 10, and 41
No. 3	12 and 13
No. 4	14, 15, 20, 21, 22, 23, 24, 25,26,27,47,48, and 52
No. 5	28, 30, 31, 32, 36, 37, 38, and 43
No. 6	4,497 feet channel, 44, 45, 46, and 50

All construction costs and installation services allocated to flood prevention will be paid for from P. L. 534 funds. All structural measures except multiple-purpose structure #46 are single-purpose structures for flood prevention.

Total installation costs for multiple-purpose structure #46 were allocated to purpose by the use of facilities method as required by Section 1132.1 of the Watershed Protection Handbook. The cost allocation and cost sharing computations are shown below:

Storage

		Acre Feet	Percent
Flood Prevention		344.7)	
		) -	67.1
Sediment		31.3)	
Municipal Water Supply		184.1	32.9
	Total	560.1	100.0

Cost

	Flood Prevention P.L. 534	Other	Water Supply	Total
Construction Cost	87,600	--	42,900	130,500
Installation Services	25,800	--	12,700	38,500
Administering Contract	--	100	100	200
Land, Easements, and Rights-of-Way	--	12,100	5,900	18,000
Total	113,400	12,200	61,600	187,200

Engineering Investigations

Structural Measures: A total of 35 floodwater retarding dams and 4,497 feet of channel improvement were planned. One of these, structure #46, was planned as a multiple-purpose dam to provide 60 million gallons of water for municipal use.

Floodwater Retarding Dam Procedure: Thirty-four sites were surveyed in detail to produce 5-foot contour interval topographic map. The scale of each map was 50 or 100 feet to the inch, depending on the topography of the site. Levels to each site were carried from U.S.G.S. bench marks. In addition to the 34 sites surveyed, site #48 was included in the plan without a detailed survey, as survey permission was denied.

An estimate of the stage-storage relationship was developed by planimetering the area bounded by the contours and a line 50 feet upstream

from the proposed centerline and then computing the stage-storage by the average-end-area method. A rough stage-storage curve for site #48 was prepared in the same manner by using a U.S.G.S Quadrangle sheet (1/62,500) instead of a detailed site survey map.

The invert of all orifices except the multiple-purpose dam was set at sediment pool elevation.

Stage-discharge curves were produced using the following formulas: Orifice, $Q = KA\ (2gh)^{\frac{1}{2}}$; weir, $Q = KLH^{3/2}$; conduit, $Q = KA(2gh)^{\frac{1}{2}}$ and the procedure described in Technical Release No. 2 for Emergency Spillways.

For the first cost estimate the emergency spillway elevation was set by an approximate method and the top of the dam was estimated to be approximately 10 feet above this elevation. Earth volumes were computed by the average-end-area method and include all elements of the fill as well as backfill. Costs per cubic yard were read from a current cost per cubic yard curve, based on actual contract bids of construction in West Virginia.

The data in the plan consisted of refining the above information after detailed surveys of sites as follows:

1. The stage-storage curve was revised to compensate for the structure in place.

2. The final elevations for the emergency spillway design storm and freeboard storm were set by graphical flood routing, using method #2 of Section #5 of the National Engineering Handbook.

3. The top of multiple-purpose dam #46 was set by the standard wave freeboard equation - $f_w = 0.0206\ D^{\frac{1}{2}} - 0.117\ D^{\frac{1}{4}} + 2.5$.

4. A final cost estimate was made in same manner as first estimate after the final yardage of fill was determined.

The invert of the floodwater retarding orifice of the multiple-purpose dam was set at the maximum stage of the municipal storage pool. The floodwater portion of the structure was designed in accordance with the above mentioned floodwater design criteria plus compliance with SCS Memorandum #40.

The geologic investigation of the sites revealed soft shales to hard shales at emergency spillway crest elevations. No emergency spillway has a design velocity greater than 15 fps.

Site #41 was not designed as a structure in series. It was designed as if structures #6 and #10 did not exist. The increased storage as a result of this design not only increases the safety of this large structure, but provided a more favorable location for the emergency spillway.

Table 3 of this plan shows more specific details of each structure.

Channel Procedure: A survey was made by running a traverse from a point 500 feet above the confluence of Patterson Creek and the upper end of the millrace down the millrace to a point on Patterson 500 feet below the millrace outlet. Stations were set approximately every 100 feet along the traverse with elevations carried to each station. All elevations were tied to U.S.G.S. bench marks. Cross sections were run perpendicular to the traverse. A topographic map was plotted to a scale of 50 feet to the inch with 1 foot contour intervals. The location of the channel centerline was drawn on the map. A profile view of the channel centerline and control points were plotted to a scale of 1" = 50' horizontal and 1" = 2' vertical. The grade of the new channel was determined from existing control points and channel conditions. The improved channel size was obtained from the water-surface profile computations explained under Hydrologic and Hydraulic Investigations. Cross-sections were plotted at each 100 foot station along

the new centerline. These sections were then revised to show the new channel size and location. The amount of excavation was determined by planimetering the cross-sectional areas and computing the volume by the average-end-area method.

Geologic investigation of the channel indicated that no rock excavation would be involved.

For more specific information on the channel, see Table 3A.

LOCATION MAP

PROJECT MAP
PATTERSON CREEK WATERSHED

MINERAL AND GRANT COUNTIES,
WEST VIRGINIA

LEGEND

Drainage Area Controlled by Structure.

Area Benefited.

PROJECT MEASURES

Floodwater Retarding Structure.

Multiple Purpose Structure.

(25) Site Numbers.

Channel Improvement for Flood Prevention.

D / E Reach Boundary.

0 1 2 3 MILES

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